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REMARKS

Claims 1 to 50 are pending. Claims 1 to 24, 26, 34 to 39 and 42 are canceled and claims 49 and 50 are new.

No claims are allowed.

1. The Applicants would like to thank Examiner Carol Chaney for the time she took on December 17, 2003, to discuss the merits of the application and pending claims with their attorney.

2. The substance of the interview is as set forth by the Examiner in the Interview Summary of November 17, 2003.

3. The Examiner indicates that claims 1 to 24 are drawn to a method of making a material and claims 25 to 48 are directed to a battery and battery cathode. The Applicants elect to prosecute claims 25 to 48 and cancel claims 1 to 24, without prejudice.

4. Claims 25, 27, 28, 31 to 34, 36, 37, 40, 41, 43, 44, 47 and 48 are rejected under 35 USC 102(b) as being anticipated by Crespi (U.S. Patent No. 5,221,453). Crespi discloses silver vanadium oxide as a cathode material synthesized in a combination reaction of silver vanadate (AgVO_3) or silver oxide (Ag_2O) mixed with vanadium pentoxide (V_2O_5). These reactions are described at column 1, lines 66 to column 2, line 38. The product material has a stoichiometric formula of $\text{Ag}_2\text{V}_4\text{O}_{11}$ or $\text{Ag}_2\text{V}_4\text{O}_{11-y}$, where

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y ranges from 0.25 to 0.35, depending on whether the reaction is carried out in an oxidizing or inert atmosphere. In the example beginning at column 2, line 41, AgVO_3 and V_2O_5 powders are milled together and heated at 520°C under a flowing argon atmosphere to make $\text{AgV}_4\text{O}_{11-y}$ and under a flowing oxygen atmosphere to make $\text{AgV}_4\text{O}_{11}$. Crespi also states that Ag_2O and V_2O_5 powders in a 1:2 mole ratio can be reacted "under the same conditions to produce the same products"; presumably $\text{Ag}_2\text{V}_4\text{O}_{11}$ or $\text{Ag}_2\text{V}_4\text{O}_{11-y}$, depending on whether the reacting atmosphere is air or inert, respectively. Crespi's synthesis techniques are stated to be improvements over the prior art decomposition reaction of silver nitrate (AgNO_3) and vanadium pentoxide, but without the evolution of noxious gaseous byproducts (NO_2). See column 1, lines 16 to 23.

At column 3, lines 10 to 23, Crespi discuss the X-ray diffraction pattern of $\text{Ag}_2\text{V}_4\text{O}_{11}$ made by the prior art decomposition method (from AgNO_3 and V_2O_5 , Fig. 3a) and that synthesized according to her invention (Figs. 3b and 3c). Crespi states "Plots 3b and 3c are essentially identical, but Plot 3a has a higher background level, indicating lower crystallinity of material. Although the peaks are in the same position in all the plots, they are sharper in 3b and 3c than in 3a, and in some cases, two distinct peaks appear in 3b and 3c where one broad peak appeared in 3a. These observations all indicate a higher degree of crystallinity in 3b and 3c than in 3a, which is surprising because higher crystallinity is often associated with low rate capability in metal oxide

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cathodes."

From this, the reasonable conclusion one skilled in the art would have drawn is that $\text{Ag}_2\text{V}_4\text{O}_{11}$ can be produced from $\text{AgVO}_3/\text{V}_2\text{O}_5$ or $\text{Ag}_2\text{O}/\text{V}_2\text{O}_5$ in a combination reaction by heating the ingredients in an oxidizing atmosphere. If the same ingredients are heated in an inert atmosphere, the product is an oxygen deficient material having the formula $\text{Ag}_2\text{V}_4\text{O}_{11-y}$. The only perceptible difference is that one product material is more crystalline than the other. Conducting the combination reaction in an inert atmosphere also means not having to dispose of noxious gaseous byproducts. Nonetheless, the competing synthesis techniques result in essentially the same material (ε -phase SVO), with only crystallinity being affected.

It is interesting to note that in U.S. patent Nos. 4,310,609 and 4,391,729, both to Liang et al., which are discussed at column 1, lines 10 to 35 of Crespi as teaching the prior art decomposition reaction, the starting ingredients were only heated to a maximum temperature of 360°C (see column 4, lines 37 to 40 of the '609 patent). It is well known in the art that heating an SVO material to 360°C in comparison to 520°C results in a substantially different degree of crystallinity. The higher the heating temperature, the more crystalline the resulting material until the melting temperature is reached. Silver vanadium oxide melts at about 680°C. Therefore, not only is it not surprising that Crespi's 520°C synthesized SVO is more crystalline than that made by Liang et al., it is entirely expected.

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Independent claims 25 and 40 have been amended to set forth that the cathode active product of the Applicants' invention comprises γ -phase SVO ($Ag_{0.8}V_2O_5.4$), ϵ -phase SVO ($Ag_2V_4O_{11}$) and elemental silver. This active mixture is obtained because the Applicants' preparation technique occurs in a reduced oxygen-containing atmosphere in comparison to ambient air. According to new dependent claims 49 and 50, the reaction atmosphere contains carbon dioxide in addition to air. Depending on the reactant silver-containing compound and the vanadium-containing compound, the contents of the final active product range from about 30% to about 70% γ -phase SVO, about 30% to about 70% ϵ -phase SVO, and about 1% to about 15% silver metal. This mixture of active constituents comprising the cathode active material of the Applicants' invention is clearly not the same as the ϵ -phase SVO made by Crespi, regardless whether the reaction atmosphere contains oxygen, or not.

The Applicants would like to now draw the Examiner's attention to the publication titled "Solid-State Synthesis and Characterization of Silver Vanadium Oxide For Use As A Cathode Material For Lithium Batteries", by Leising et al., Chem. of Mat. 6 (1994), pp. 489-495. This publication was entered into the record of the application with the Second Supplemental Information Disclosure Statement filed December 12, 2003. At Table 7, pg. 494 of the publication, discharge capacities for Li/SVO cells are listed. The SVO materials were synthesized using various starting materials heated to 500°C in either air or argon.

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In particular, the discharge capacities for SVO made from AgNO₃ (air), AgVO₃ (air) and Ag₂O (air) are listed. In each case, the silver-containing material is combined with V₂O₅. According to Crespi, a synthesis containing the former material is a prior art decomposition reaction while the latter two materials (AgVO₃ and Ag₂O) are combination reactions. The capacity results to both a +2.0V and a +1.5V cut-off are close enough for all of the materials as to not show a statistically significant difference between the decomposition reaction derived material and the combination reaction materials.

Turning now to the examples in the Applicants' specification, Example 1 on page 16 is a decomposition reaction for SVO derived from AgNO₃ and V₂O₅. This material is similar to that which was used to construct Table 7 in the Leising et al. publication. In contrast, Example 3 describes a preparation for SVO according to the Applicants' claimed invention. In this example, the reactants are Ag₂CO₃ and V₂O₅ heated in a reduced oxygen atmosphere of 95% CO₂/6% air. On page 17, line 23+, test cells were constructed with the result that the SVO material of Example 3 had improved dc resistance in comparison to the prior art material of Example 1, as shown in Fig. 2. Further, Fig. 6 is an overlay of the pulse discharge results of cells built with the SVO materials of Examples 1 and 3. As discussed at the top of pg. 19, "the largest improvement in cell resistance is for that of test cell 3 (Example 3), which included the SVO synthesized under the rotation treatment."

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Carrying out the Applicants reduced oxygen atmosphere synthesis under a rotation treatment is an aspect of their invention that is not necessarily critical for improved discharge performance. On page 20, the SVO material of Example 6 was made from $\text{AgNO}_3/\text{V}_2\text{O}_5$ in air. This is the decomposition reaction discussed by Crespi. In contrast, the SVO material of Example 7 was made from $\text{AgCO}_3/\text{V}_2\text{O}_5$ in a reduced oxygen atmosphere of air and CO_2 . However, the reactants were not subjected to rotation treatment. Instead, they were placed in an aluminum pan and heated in a tube furnace under a flow of carbon dioxide and air (about 94% CO_2 /6% air). The SVO material of Example 8 was produced in a similar manner except the furnace contained a flow of about 84% carbon dioxide and about 16% air.

Respective test cells were then pulse discharged as described at page 21 of the specification. The results are graphed in Fig. 9 where it is concluded that "test cells 7 and 8 assembled with cathodes having SVO synthesized under the respective carbon dioxide/air mixtures again showed a lower dc resistance than that of test cell 6 containing SVO synthesized in an ambient air atmosphere."

Thus, it is the Applicants' position that the Leising et al. publication teaches that the discharge capacity of a Li/SVO cell is not significantly different whether the cathode active material is produced by a decomposition reaction of $\text{AgNO}_3/\text{V}_2\text{O}_5$ in air (Liang et al.) or by a combination reaction of $\text{AgVO}_3/\text{V}_2\text{O}_5$ in air (Crespi). However, according to the Applicants', a lithium cell

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containing SVO made according to their invention as set forth in amended independent claims 25 and 40 is a significant improvement over both an SVO material made by a decomposition reaction and by a combination reaction according to Crespi. This is clearly brought forth in the examples in their application, as described above.

Furthermore, one skilled in the art at the time of Applicants' invention would not have believed the present cathode active material was obvious in light of the cited Crespi patent. The only active materials Crespi teaches are $\text{Ag}_2\text{V}_4\text{O}_{11}$ and $\text{Ag}_2\text{V}_4\text{O}_{11-y}$. These ϵ -phase SVO materials would not have suggested to the skilled artisan that when the active material contains γ -phase SVO and silver metal in addition to ϵ -phase SVO, it results in improved discharge performance.

Accordingly amended independent claims 25 and 40 are believed to be neither anticipated by nor obvious in light of the cited Crespi patent. Claims 27, 28, 31 to 33, 41, 43, 44 and 47 to 50 are allowable as hinging from patentable base claims. Claims 34, 36 and 37 are canceled.

Reconsideration of this rejection is requested.

5. Claims 25, 28, 32, 34 and 37 are rejected under 35 USC 102(b) as being anticipated by Yamamura et al. (JP 03 093628). This published application teaches mixing silver powder and V_2O_5 , and heating the reactants in an evacuated glass quartz tube having either a vacuum or an inert gas therein. In that respect, the synthesis

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technique of this reference is very similar to that taught by Crespi. In the latter, the reactants are AgNO₃ and V₂O₅ while in the former they are Ag and V₂O₅. However, in both cases, the reactive mixture is heated in an atmosphere that does not contain oxygen, much less one having a reduced oxygen atmosphere, as set forth in amended independent claim 25. For that reason, the arguments and discussion set forth above with respect to the Crespi patent are equally applicable to Yamamura et al.

Accordingly, it is believed that amended independent claim 25 is patentable over Yamamura et al. Claims 28 and 32 are allowable as hinging from patentable base claims. Claims 34 and 37 are canceled.

Reconsideration of this rejection is requested.

6. Claims 26, 29, 30, 35, 38, 39, 42, 45 and 46 are rejected under 35 USC 102(b) as anticipated by or, in the alternative, under 35 USC 103(a) as obvious over Crespi. The Examiner states that "Although Crespi et al. does not recite specific components of their inventive active material, the methods for making the products are essentially identical with those of the instant invention." The Applicants believe this statement is a simplistic view of their inventive synthesis in comparison to that of Crespi's. As set forth in section 4 above, the competing methods are not at all similar and, consequently, they do not result in similar active products.

Accordingly, the inclusion of the subject matter of

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canceled claims 26 and 42 in amended independent claims 25 and 40, respectively, is believed to result in patentable base claims. Claims 29, 30, 45 and 46 are allowable as hinging from the base claims. Claims 35, 38 and 39 are canceled.

Reconsideration of this rejection is requested.

7. Claims 49 and 50 are new and hinge from amended independent claims 25 and 40, respectively. These dependent claims set forth that the reduced oxygen atmosphere contains carbon dioxide.

8. The prior art made of record and not relied upon has been reviewed. However, it is not believed to be more relevant to the patentability of the pending claims than the presently cited prior art.

It is believed that claims 25, 27 to 33, 40, 41 and 43 to 50 are now in condition for allowance. Notice of Allowance is requested.

Respectfully submitted,



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